2006 DOE Hydrogen, Fuel Cells &
Infrastructure Technologies Program Review

NextEnergy Microgrid and Hydrogen Fueling Facility

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This presentation does not contain any propriety or confidential information

Project ID#
TVP 6

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Overview

Timeline

- Project start date: January 3, 2005
- Project end date: March 30, 2008
- Percent Complete: 28% at April 21, 2006

Budget

- Total Project Funding: $3,923,995.00
  - DOE Share $1,926,744.00
  - Contractor Share $1,997,251.00
- FY04 DOE Funding Received: $0
- FY05 DOE Funding Received: $0
- FY06 DOE Funds: $483,000.00
- FY07 DOE Funds: $1,267,870.00
- FY08 DOE Funds: $175,874.00

Barriers

- Station design
- Urban Setting
- Integration into multi-use site
- Construction and O&M Safety

Partners

- State of Michigan
- City of Detroit
- Wayne State University
- DaimlerChrysler
- BP International

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Overview

NextEnergy Contribution to DOE Barriers

The NextEnergy Hydrogen Station will contribute to alleviating the DOE listed barriers related to:

- Technology Validation: directly in the areas of Hydrogen Refueling Infrastructure and Codes and Standards (Section 3.5.4.2 Parts C & E).
- Hydrogen Production: indirectly by providing a flexible validation platform for all forms of hydrogen generators (Section 3.1.4.2.1 Parts A – F and Section 3.1.4.2.2 Parts G & H).
- Safety: directly by providing safety data based on real construction and operating experiences of this multi-use, multi-feedstock platform (Section 3.7.4.2 Parts A, B, D).

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Objectives

- To support the DOE "Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project" in the greater Detroit area.
- To integrate, within a core urban environment, critical hydrogen infrastructure components and systems for multi-use operations.
- To optimize integrated, system-based solutions to advance hydrogen infrastructure for vehicular and stationary distributed power generation use.
- To provide a flexible "test" platform to advance the development and validation of commercial-type on-site hydrogen generation technologies.

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Approach

- Develop the hydrogen station in 5 phases to match the forecasted needs of the station's users:

  Phase 1 – supply hydrogen to the NextEnergy Center Microgrid via tube trailers to fuel the hydrogen-based products (i.e. fuel cells & engine-generator sets).

  Phase 2 – supply hydrogen to a packaged vehicle fuelling system via tube trailers (in co-operation with DaimlerChrysler and BP International).

  Phase 3 – install permanent storage and the associated equipment such as the Gas Control Panel, the hydrogen compressor, the electrical switch gear and control & communication equipment.

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Approach

Phase 4 – install 5 hydrogen generator "test bays" and fill one test bay with equipment that will allow NextEnergy to produce ultra-high purity hydrogen on-site for use in OEM "fuel cell" vehicles.

Phase 5 – install one additional high purity on-site hydrogen generator.

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Technical Accomplishments / Progress / Results

- Engineering design commenced January, 2005.
- Engineering design for Phase 1 completed February, 2005.
- Preliminary engineering design, equipment specification and installation specification for Phases 1 through 5 completed to support the revised Project Budget submitted to DOE March, 2005.
- Phase 1 commissioned and operational June, 2005.
- Grand Opening of NextEnergy Center September, 2005.
- Phase 2 design and engineering commenced November, 2005.
- Phase 2 construction contract awarded February, 2006.
- Participated in 2 DOE HSRP Reviews (July / 05 – Phase 1 and Jan / 06 – Phase 2).

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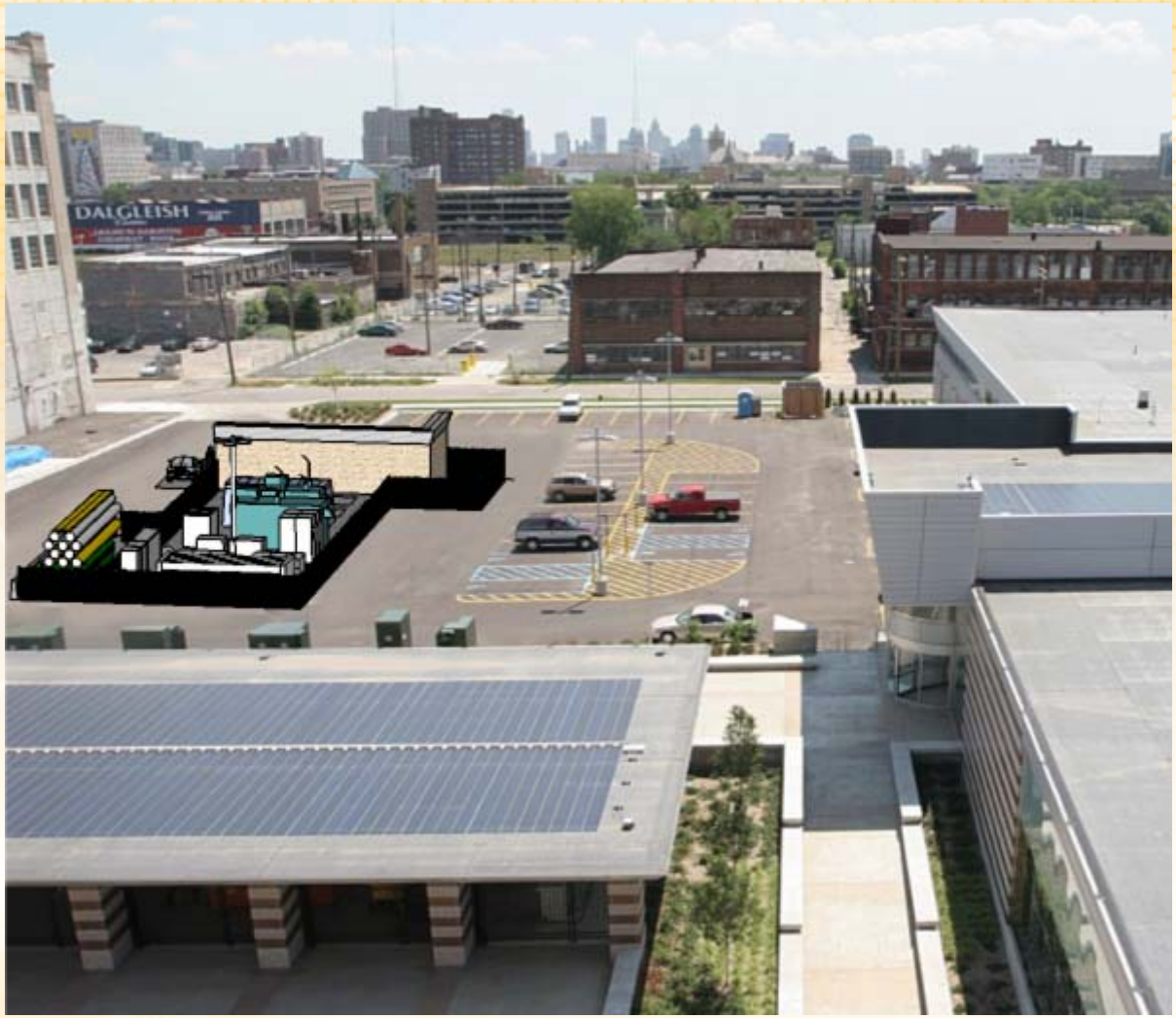

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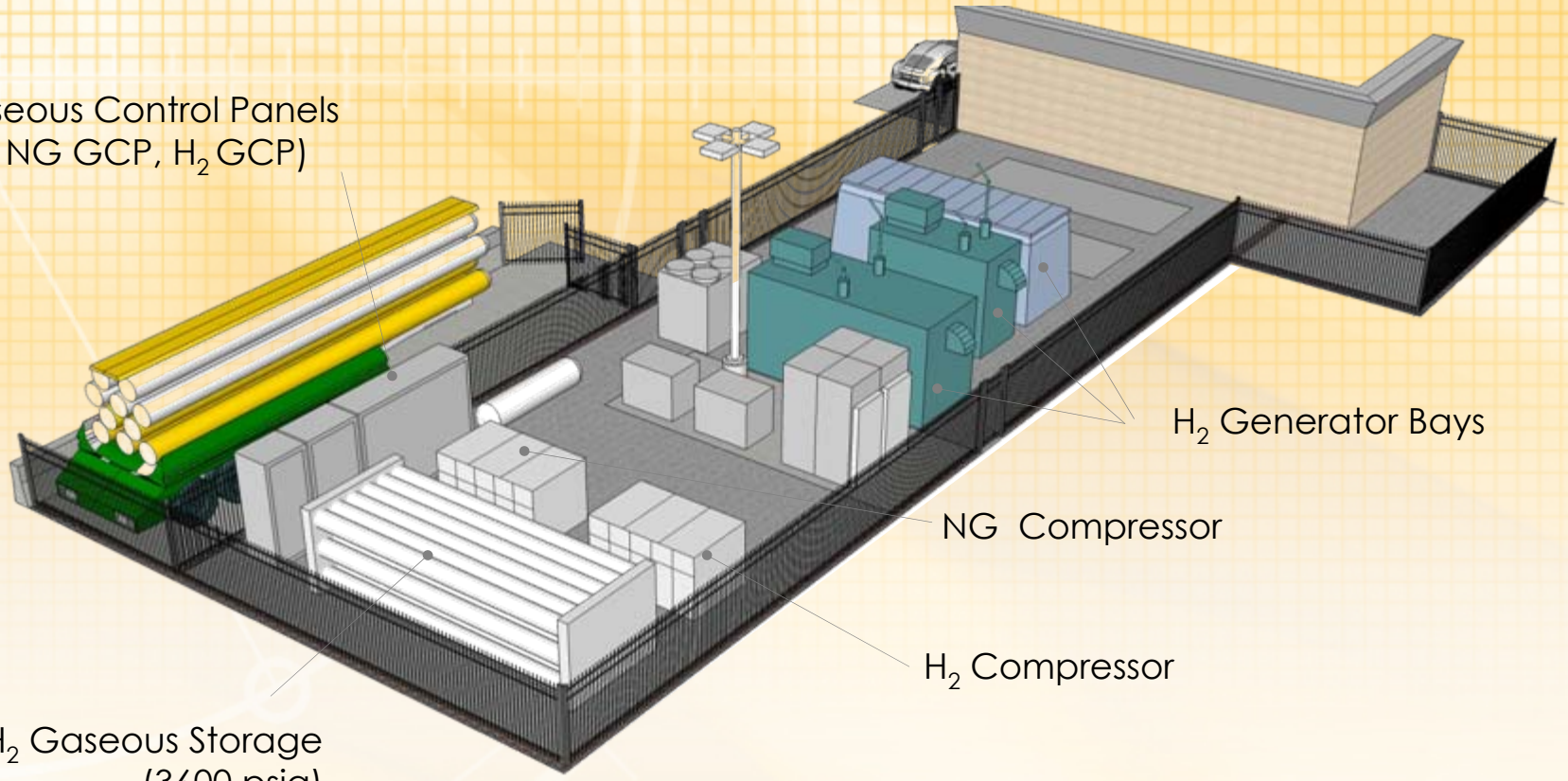

Alternative Fuels Platform

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H_2 Fuel Dispenser

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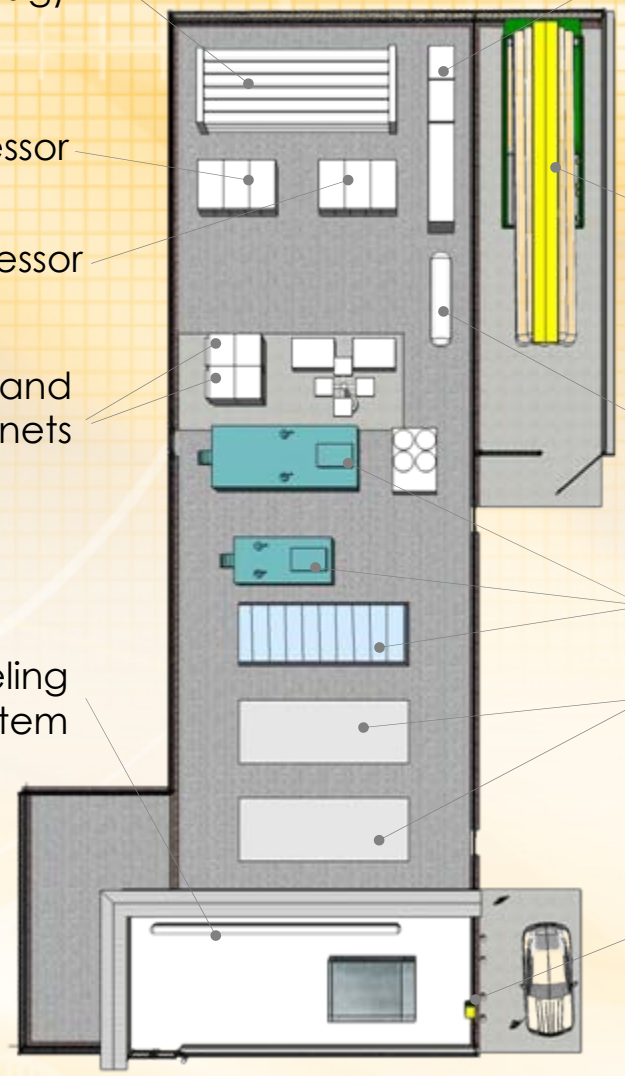

Alternative Fuels Platform

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Technical Accomplishments / Progress / Results

Phase 2 work on track to be completed May 12, 2006

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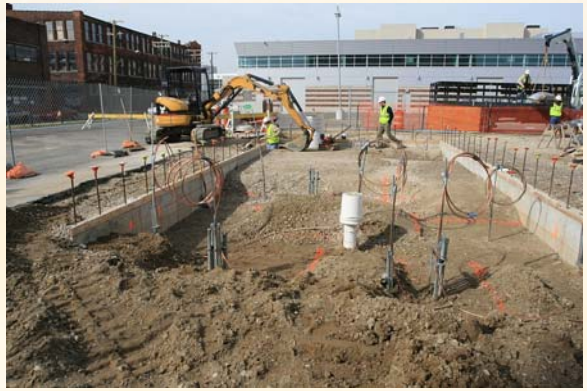
Technical Accomplishments / Progress / Results

Phase 2 work on track to be completed May 12, 2006



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Future Work
(through May 31, 2008)

- Complete Phase 2 by May 12, 2006.
- Complete the Engineering, Design and Equipment Selection for Phases 3 & 4 by August 31, 2006.
- Build and commission Phases 3 & 4 by March 30, 2007.
- Install Phase 5 by March 30, 2008.

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Responses to Previous Year Reviewer's Comments

1. **How will NextEnergy manage and control the safety aspects for a site of this complexity?**

   NextEnergy is committed to developing and operating a "world class" facility. NextEnergy embraces the concept of Safety-by-Design and validates its work through Failure Modes and Effects Analyses (FMEA's) at the component level and Hazard Identification and Risk Analyses (HIRA's) at the system level.

   NextEnergy is currently in the process of installing Phase 2 (the Vehicle Fueling Station) with its partners DaimlerChrysler and BP International. Through this collaboration, the NextEnergy Safety and Operational review process will benefit from the integration of these other corporate programs.

   In addition, the DOE Hydrogen Safety Review Panel has selected the NextEnergy project to pilot its new Project Review strategy.

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Responses to Previous Year Reviewer's Comments

2. **How has NextEnergy addressed the concerns of the public, especially those neighboring the Center's property?**

As part of NextEnergy's State mandate we have engaged in public education since our inception in 2002. After our property was purchased from Wayne State University and before the start of construction, we initiated a dialogue with our neighbors and key stakeholders to describe what we were planning to do. We periodically invited them to meetings and encouraged them to participate in our programs. NextEnergy is the beneficiary of strong community support from our TechTown neighbors, from the entire southeast Michigan area and at the state capitol.

We have also engaged in an ongoing dialogue with municipal and state Authorities Having Jurisdiction. This has resulted in a deeper understanding of the facility that has, in turn, led to very quick Permitting Reviews.

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Responses to Previous Year Reviewer's Comments

3. **Is NextEnergy capable of handling 700 barg (10,000 psig) hydrogen for vehicles?**

Yes, the current design specifies dispensing at 350 barg (5,000 psig). We are accomplishing this task by utilizing a packaged vehicle fueler.

In the future, we are positioned to install a second vehicle dispenser.

NextEnergy has developed the preliminary design for a 700 barg storage demonstration. We are currently seeking industry partners who are interested in developing data on 700 barg gaseous ASME and composite ground storage technologies complemented by 700 barg compression and dispensing equipment.

This work would be in addition to the current DOE scope of work and would represent our first "demonstration" project to help fulfill the DOE program missions.

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Publications and Presentations

- NextEnergy has referred to the Hydrogen Station in several overview-type presentations including presentations to several state and local Authorities Having Jurisdiction, the U.S. Department of Defense, several Michigan universities and colleges, local chapters of professional societies, national labs and other national organizations such as SAE and NASFM.
- NextEnergy has used the specific design parameters of the Hydrogen Station in presentations to the State of New Mexico and the State of Oklahoma.
- NextEnergy has developed an Emergency First Responders presentation and is delivering it throughout the State of Michigan.
- NextEnergy has not released any operating data about this facility.

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Critical Assumptions and Issues

1. **The most significant hydrogen hazard associated with this project is:** Shear failure of the hydrogen piping between the Gas Control Panel and Storage.

   Our approach to deal with this hazard is:

   - Safety-by-Design validated through Failure Modes and Effects Analyses (FMEA's) and Hazard Identification and Risk Analyses (HIRA's).
   - Comply with all codes and standards for the design, construction, operation & maintenance of this station including designating much of the station's area as a Class I, Division 2 electrical zone.
   - Multiple piping lines to diversify the risk of all storage being dedicated to one pathway.
   - Normally closed / fail closed actuators.

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Critical Assumptions and Issues (continued)

Our approach to deal with this hazard is (continued):

- Tubing and fittings designed for this application and tested to ASME B31.3.
- Mechanical piping protection including venting and mechanical excess flow valves.
- Physical barriers to restrict access to this area.
- O&M procedures that limit access to this area to "authorized persons" and mandatory work permitting.
- Continuous monitoring of the mass of hydrogen in storage including alarming and closed loop control if an unexpected discharge of hydrogen is detected.
- 3rd party safety reviews by NextEnergy's partners including the DOE Hydrogen Safety Review Panel, DaimlerChrysler and BP International.

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Critical Assumptions and Issues (continued)

2. **The most significant design changes to accommodate current "test bay" client needs are:** The ability to supply liquid fuels to "test bay" equipment. The ability to accept up to 1 MW of 480V, 3 phase power from "test bay" equipment and export it to the local electric grid.

   Our approach to deal with these needs:

   - Preliminary engineering design is under way to understand the implications of these changes on the overall design.
   - Conduct a Change Control Review to evaluate the affects of these changes.
   - Develop a clear demarcation point between the current design and the proposed improvements such that the improvements can be easily interfaced to the current system.
   - Develop a preliminary budget and associated project schedule to quantify the impact of these improvements.

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Critical Assumptions and Issues (continued)

3. **The potential need to install new equipment to comply with the applicable codes and standards that have been modified or implemented since the project was started:** This includes the possible need to install an additional Gas & Flame Detection System.

   Our approach to deal with this issue is:

   - The vehicle fueling portion of the facility includes a gas & flame detection system. We need to consider installing a second system to monitor the ground storage and associated equipment.
   - The State of Michigan is reaching the conclusion of the development of its state wide Hydrogen Code. To the greatest degree possible, we need to ensure that our design conforms with this code.
   - Conduct a Change Control Review to evaluate the affects of any code-driven changes.
   - Develop a preliminary budget and associated project schedule to quantify the impact of these changes.

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